"THE CONSTRUCTION AND OPERATION OF THE PLANT

OF THE

WASHINGTON BRICK COMPANY AT MUIRKIRK, MD."

A THESIS PRESENTED AS A REQUIREMENT FOR

MEMBERSHIP IN TAU BETA PI.

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SUMMARY

The new plant of the Washington Brick Company is located at Muirkirk, Maryland twelve miles north of Washington D.C. on the Washington-Baltimore Blvd. It is of interest because it uses the Circle System which is a revolutionary design in the construction of brick plants.

The plant is composed of two main structures, the preparations building and the Circle. The clay is prepared for burning in the preparations building and is burned in the Circle.

The clay is dug from supply pits behind the preparations building by steam shovels and is loaded into dinkey cars. These cars are brought to the top floor of the preparations building where the clay is dumped into a hopper. The clay then passes through a series of three sets of rolls. The first breaks up the clods, the second reduces the size of the clay and removes the rocks, the third reduces the clay to a fine powder. The clay is then carried to the machine room by a belt conveyor.

The Circle is a circular structure 140 ft. in diameter. The inner diameter is 98 ft. The area between these circles is divided into 16 permanent kiln bottoms. The machine room stands in the center of the Circle. As the clay enters it is fed to a brick machine and cutter which form and cut the bricks. From the cutter the bricks are taken by another belt conveyor to the kilns. The machine room can turn so as to feed bricks to any kiln section.

The burning is done by the two burning units on the Circle. A burning unit is composed of 4 hoods, drying, preheating, heating and cooling. The hoods are composed of steel sides on the inner and outer circles and a flat arch acros the top. These hoods are moved around the circle on rails. Once the bricks are set in a kiln they are cooled by a fan in the drying kiln, then the hoods are moved and the bricks are preheated in pre-heating kiln by the combustion gases from the firing kiln. Then the firing kiln is moved up and the bricks are fired by oil burners. They are then cooled in the cooling kiln. The hoods are then

on and the bricks are left exposed so that they may be loaded directly into trucks.

The Circle System has many advantages over the older type of plant. The main advantages are in initial cost, simplicity of arrangement, low fuel requirements, low labor requirements, and flexibility of operation. The Washington Brick Company is to be congratulated on having the most modern brick plant in the country.

"THE CONSTRUCTION AND OPERATION OF THE PLANT OF THE WASHINGTON BRICK COMPANY AT MUIRKIRK, MARYLAND."

INTRODUCTION

The new plant of the Washington Brick Company is located at Muirkirk, Maryland twelve miles north of Washington D.C. on the Washington-Baltimore Boulevard. It was built in 1938. The plant is of special interest because it is the first plant, and the only one at this date, to be constructed using the Circle System which is a revolutionary design in the construction of brick plants. It is an entirely new approach to the solution of the numerous and varied problems of brick manufacture. It is an attempt to cheapen the manufacture of brick, building tile, and similar ware by minimizing the amount of labor by mechanization as well as by compact arrangement. The system was invented by John R. Clark, who is at present Sales-Manager of the organization, and designed by T. W. Garvee.

The essential features of the construction and operation of the new plant are here presented.

GENERAL

To orient the reader Picture No. 1 has been included.

Picture No. 1 (Courtesy of Wash. Brick Co.)

This is an aerial photo which clearly shows the entire plant with the exception of the clay supply pits which are farther to the right than the view shown. On the far right can be seen the tracks leading from the supply pits into the white building in which the clay is prepared. From the bottom of this building can be seen the belt conveyor carrying the prepared clay over the roof of the Circle and into the machine room in the center of the Circle. The machine room contains the brick machines and a belt conveyor which transports the green bricks to the Circle. The circular white-domed structure is the Circle which contains the kilns. All the heating processes are carried on in this structure. In addition to these structures, the fuel heating and pumping building can be seen just to the left and behind the preparations building. The general offices of the company are housed in a small brick building located about where the construction shack is in the lower left hand corner of the photo. This in brief is a birds-view of the entire plant of the Washington Brick Company.

PREPARATION OF THE MATERIAL

The clay or shale from the manufacture of the bricks is dug from the ground behind the plant. Here the company owns an area of land sufficient to supply soft clay for an indefinite period.

Picture No.2

This area is shown in Picture No.2 which was taken from the tracks

immediately behind the preparations building. The area extends all the way to woods shown in the picture. The clay is dug by steam shovels and dumped into side-dump cars or dinkeys which run upon light tracks which can be moved about so as to stay near the immediate source of supply. The steam shovels and a line of dinkeys can be seen in the left-center of Picture No.2. Also the area of clay already cut out can be seen. The dinkeys are pulled by a small gasoline engine into the top floor of the preparations building. It is interesting to note at this point that only one man is necessary to dig the clay and bring it to the preparations building. This is under ordinary conditions of course but more men can be added as needs increase.

In the preparations building the cars are dumped from either side into a hopper which leads the clay through a granulator. The granulator is merely a set of screw-shaped rolls which break up the big clods of clay and reduce it all to a uniform size. The clay then passes downward through a set of conically-shaped rolls which further reduce the size of the clay and kick out any stones which may be present. The clay now passes through a third set of rolls. These are smooth rolls running at different speeds and serve to reduce the clay to a fine powder. The path of the material is downward through the rolls by gravity. All rolls are run by electricity, suitable machinery having been installed for that purpose. A pit under the smooth rolls accommodates the tail end of a belt conveyor which carries the clay to the Circle.

Picture No.3
Preparations Building
and
Conveyor

Picture No.3 shows the preparations building and the belt conveyor carrying the clay from the pit beneath the smooth rolls into the Circle. Picture No.5 gives another view of the conveyor. This picture was taken during construction and the belt has not been put on yet. This leaves the rollers uncovered so that they may be clearly seen. The light steel structure which supports the rollers and the belt is also clearly visible. This structure connects to the top of the machine room as will be explained more fully later. Here again it is interesting to note that only one man is necessary to run the whole system of three sets of rolls and the conveyor.

DESIGN OF THE CIRCLE

Kilns and Hoods

The Circle is 140 feet in diameter, outer edge to outer edge. The inner diameter is 98 feet. The area between these two circles is divided into 16 permanent kiln bottoms each 21 feet in width and 27 ft. 6 in. in length center to center of partitions along the outer circumference. The kiln sections accommodate approximately 105,000 bricks set 33 high or about 12 feet.

Picture No.4

Picture No.4 is a view of the Circle from the outside. The supporting

columns of the roof are not the kiln divisions,the kilns being about one and one-half times the distance between these columns.

The kilns are designed as a downdraft kiln system. The downdraft kiln is used instead of the updraft kiln,despite its greater fuel consumption, because of the excellence of the results due to the effective control it provides over the kiln atmosphere. This effective control insures the production of every colour effect by oxidizing and reducing conditions and also special colors by the use of minerals or salts in the final stages of firing such as zinc to produce green,manganese for black, and common salt for glazing, etc.

Picture No.5(Courtesy of Wash.Brick Co.)

Picture No.5 has been included because having been taken during construction it reveals many features of the Circle which could not be seen on a photo taken after completion. This picture will be referred to from time to time.

Each kiln bottom contains parallel 9 inch flues and a connecting flue in the center leading to the circular main draft flue which runs completely around the circle. Picture No.5 shows the kiln bottoms with the 9 inch flues running parallel to the radius of the circle. Each kiln collecting flue has a damper before its entrance into the main circular flue. The circular main draft flue has a damper between each 2 kiln section. All dampers are flat and sloping and are operated by a transportable hoisting frame equipped with a suitable winch.

The partitions or end walls which separate the kiln sections are permanent being made of brick 12 inches thick. The dimensions of these radial walls are slightly smaller in width and height than the kiln hoods than the inside measurements of the kiln hoods so that these hoods can pass over.

The kiln hoods are in the shape of an inverted "U" having side walls on the inner and outer circles and a flat arch across the top. Picture No.5 shows a hood in the process of construction. The hood appears to the left of the conveyor. The walls of the kiln can be clearly seen but the arch across the top has not been constructed as yet.

There are two complete burning units in the circle,each unit containing a drying hood, a preheating hood,a firing hood,and a cooling hood. All hoods may be recognized by their outer steel shells and their rigid top and side bracing to maintain the guage.

Picture No.6

Circle,showing outside of burning unit.

Picture No.6 is a view of the Circle with the burning unit visible. The heavy side bracing can be clearly seen. The burning unit takes up a quarter of the Circle. The other burning unit is on the opposite side of the Circle.

The drying hood is lightest in design and consists of a light guage outer steel shell and an inner shell of asbestos-cement plates with a 3" space of diatomaceous earth. The ceiling is provided with numerous outlets permitting regulation of the drying processes.

The preheating,firing,and cooling hoods differ from the drying hoods by their insulating refractories.These refractories consist of light weight refractory brick secured to the housing along the sides and suspended from a structural steel bracing in the top by means of pipes,hooks and rods.

The firing hood has a 9" brick lining and the other hoods have a 4.5" lining. There is no steel plate back of the refractories at the crown of the hoods so that the inside of the hood may be inspected. The firing hood has a special working platform provided below the burners on each side of the hoods, adequate openings in the hood side being made for the adjustment of burners and observation through peep-holes. The hood shown in Picture No.5 is a firing hood and the special platform and peep-holes are clearly visible.

Picture No.7

Picture No.7 is a view of the burning unit from the inside of the

Circle . This shows the firing kiln in the center with its special platform. On the kiln to the right may be seen the pyrometers which are on each kiln so that the heating processes may be accurately regulated.

The firing of the brick is done with oil burners. The fuel used is heavy Bunker oil, and has to be heated. This is done in the little building shown in Picture No.1, which contains steam coils which heat the oil to 200°F. Tanks behind the building provide for storage of 30,000 gallons of oil. The building also contains two pumps ,one of which is an auxiliary,for pumping the oil to the Circle. The oil burners are arranged above the brick setting within the upper part of the hoods,approximately 18"below the crown. The firing hood carries the special high speed air fan and piping and oil apparatus. There are oil and electrical connections opposite each kiln.

The kilns travel around the circle on wheels which roll on circular tracks.The outer wheels are double flanged,guiding the hoods around a circular path while the inner wheels are flangeless,permitting some variation due to steel fabrication or expansion. The wheel trucks are not visible since they are located within shallow circular rail pits. These rail pits are clearly visible in Picture No.5. The total weight of each firing hood is about 60 tons or 120,000 pounds,so there is a load of 30,000 pounds on each wheel.

Along the sides,inside of the circular rails along the kiln bottom all hoods are provided with steel plates or side aprons dipping into a continuos sand trough. There is a recess in the kiln wall and a corresponding projection of the hood refractories at the bottom which acts as an additional seal. The drying hoods do not have the refractories nor the seal projections at the bottom. However,they do have the sand seal aprons which line up with those of the other hoods.

The sealing between the ends of the hoods against the permanent partition walls is made by a string of brick attached to an "H" steel beam

in their rear. The upper ends of the "H" beams are attached to standard rollers which are separate from the hoods at the junction and are easily rolled in and out the few inches needed for clearance while the hoods are being moved. The top seals are made by filling the gap between the hoods and the partitions with sand. The pre-heating, firing and cooling hoods travel together and are coupled together by a suitable coupling on each side of the hood permitting play for operating the seals.

The entire kiln bottom and all hoods are housed under a suitable light steel structure. The roof is supported by Fink roof trusses with a monitor added on top to permit the escape of combustion gases. The roofing is light corrugated metal laid on purlins which are in turn supported by the trusses. The whole roof is supported on suitable light steel columns which are braced against wind with light portal bracing. Each part of the roof construction is splendidly shown in Picture No. 5.

DESIGN OF THE MACHINE ROOM

The center of the open space within the Circle is occupied by the machine room.

Picture No. 8

Picture No. 8 was taken while standing in one of the empty kilns. It

shows the machine room as it occupies the center of the stage. The building is constructed of corrugated steel plates. At the top of the picture the belt conveyor may be seen delivering the prepared clay to the machine room. The belt conveyor delivers the clay into a pipe hopper 3 ft. in diameter. This hopper conveys the clay into a screw feeder which forces the clay under pressure into a combination brick machine. The feeder pipe also acts as a support for the belt conveyor frame. Since the conveyor is fixed, whereas the machine room turns around its center, the feeder pipe is provided at the bottom with a flange to which are bolted a series of casters which in turn with their rollers are standing on a steel plate, the latter mounted on the turntable. Thus the machine room can rotate independently of the conveyor frame.

Picture No.9

Picture No.9 is a close-up of the machine room. It shows clearly the connection between the belt conveyor and the machine room. The feeder pipe may be seen extending out of the roof of the machine room and supporting the belt conveyor. The circular plate at the junction of the two is the flange plate which permits the machine room to rotate independently of the conveyor frame. This connection is made rather loosely so that slight variations in the length of the conveyor frame due to expansion and contraction from heat and cold can-

not cause any disturbance.

The entire machine room is supported by a turntable composed of two main girders and suitable cross-beams. The turntable is supported by four wheels,one at each end of a girder. These wheels along with the girders and cross-beams were designed to carry safely in excess of sixty tons. The turntable turns on a circular rail 38 feet in diameter. All rails,including the hood rails weigh 60 lbs. per yard and are bent true to their respective circles.

The machine room is kept centered by a shaft or center bearing under the platform. This stubby shaft does not carry any load and so is made hollow to serve for the admittance of a water line and a steam line. Three contact rings are attached to the lower castings for the admission of electric power, contact being made by brushes attached to and revolving with the turn-table.

An off-bearing belt which acts as a brick delivery conveyor extends from the end of the machine room into the kiln. Its outer end is supported halfway its length,permitting up and down movement to accommodate the setting of the brick. A job crane is used to take care of this movement as well as of the shifting of the conveyor back to clear the inner building columns when the turntable is revolving to the next kiln section. The vertical boom to this jib crane is attached to the end of the platform.

Picture No.10

Picture No.10 shows the off-bearing belt carrying the bricks from the machine room to the kiln. The little chute at the side is catching the bad bricks which are returned by the brick-setters. These bad bricks are re-ground and the clay is used again so there is no waste.

OPERATION OF THE MACHINE ROOM AND THE CIRCLE

As the clay is delivered to the machine room by the belt conveyor it drops into the previously mentioned pipe hopper and thence into a screw feeder. This screw feeder forces the clay through a combination brick machine which is merely a die of a rectangular shape,its dimensions being slightly larger than those of a normal brick to allow for shrinkage. This die therefore extrudes a column of clay the cross-section of which is the size of a brick. This column is cut into bricks by a cutter which is merely a line of wires spaced a brick size apart. These wires descend upon the column of clay and lop off 15 bricks at a time. From the cutter the green bricks automatically picked up by the off-bearing belt which takes them,properly spaced, due to a belt speed greater than the speed with which they leave the cutter, into the kiln. Here a crew of 5 or 6 setters or hackers take the bricks off the belt and set them properly in the kiln. The machine room is turned at intervals to keep in step with the setting. The bricks,of course,may be fed into any kiln. The drying hood is placed over each set of bricks during drying.

Sets are made for each burning unit alternately. The time of drying is synchronized with the time firing and every third day preheating,firing, and cooling hoods are moved one kiln section ahead so that the preheating hood covers the drying kiln,etc.

The firing is done with the heavy Bunker "C" oil previously heated in the heating building. The oil is burnt by 12 burners which are in each firing hood. The fuel is introduced over the top of the setting of brick,there being a space of about 3 feet between the bottom of the crown and the top of the setting. A fan produces a downdraft in the kiln hence drawing the combustion gases

down through the brick setting and out through the kiln bottom. Here, by another fan, the hot gases are pushed in the adjacent pre-heater kiln from below, pre-heating the bricks and escaping through an opening in the crown and out through the monitor in the roof. If necessary or desirable the combustion gases can be split and used partly for pre-heating and partly for drying in the same burning unit.

For the combustion gases a centrifugal fan is used. The ducts of this fan are well insulated with a special high temperature alloy which can stand a temperature up to 1600°F before melting. The drying fan is of more standard centrifugal type. These fans are mounted on movable trucks so that they may be moved easily and quickly connected where desired.

To summarize, the kiln cycle is as follows. The drying hood is placed over the bricks immediately after being set. A standard fan dries them by creating a current of air through the kiln. After the period of drying is completed the pre-heating kiln is moved over the setting. Here the bricks are pre-heated by the combustion gases from the heating kiln. Then the heating kiln is moved up and the bricks are heated. After three days of heating the cooling kiln is moved up and the cooling of the bricks is controlled.

CONCLUSION

The advantages of the Circle System begin with the initial cost of the plant and carry right through to the storage space supplied.

The average brick plant of the older type costs $6000 per 1000 brick daily capacity. The new plant at Muirkirk cost $210,000 and with a daily output of 70,000 brick this averages only $3000 per 1000 brick daily capacity. Thus the initial cost of the plant is reduced by 50% which represents a sizable sum.

The arrangement of the plant is such as to promote simplicity as well as a saving of space. In the old tunnel type, kilns up to 400 feet long were required. The arrangement of the kilns in a circle is obviously a space saver and the saving of handling of the clay by the use of conveyors is nothing short of

ingenious. After once being set in the kilns the bricks are never touched again until ready for shipment. The 16 kiln sections provide ample storage and there is no need for second handling, the bricks being packed directly into trucks which are backed right up to the kilns.

The fuel requirements for the burning of the brick are held to a minimum by the use of the insulating refractories in the hoods and also because of the fact that the bricks are previously preheated by the waste combustion gases.

One of the greatest advantages of the system is its small labor requirements. The older type plants average 1500 brick per day per man. This plant averages 5000 brick per day per man, using only 15 men to produce their daily output of 70,000 brick.

The whole system of kilns, flues, etc. is extremely flexible and changes can be made during operation one way or the other by manipulation of a few dampers.

The plant of the Washington Brick Company, by dint of being the first to employ the Circle System, is, without a doubt, the most modern brick plant in the country. The introduction of the Circle System with its many advantages will probably revolutionize the design of plants in the brick industry. It is without a doubt the greatest contribution to the furtherance of the brick industry in many years.

FINIS

BIBLIOGRAPHY

Inasmuch as the subject of this thesis is a new structure and of an entirely new design there was no opportunity for the acquisition of material from existing books or periodicals. All of the facts for this thesis were obtained through John R. Clark, originator of the Circle System and Sales-Manager of the Washington Brick Company. Due appreciation is here accorded Mr. Clark who so kindly gave freely of his time so that this thesis might be completed.